

WHAT IS CLAIMED IS:

1. A culture system comprising:

(a) a fluid inlet;

5 (b) a first culture compartment having a tubular housing;

(c) a first end piece attached to the fluid inlet on one side and to a first end of the tubular housing on a second side,

(d) a second culture compartment coaxial with the first culture compartment, the second culture compartment having a proximal end and a distal end;

10 (e) a fluid connector having a first side mounted on a second end of the tubular housing and a second side mounted on the proximal end of the second culture compartment, the fluid connector having a through bore passing from the first side to the second side of the fluid connector;

15 (f) a connector filter positioned on the first side of the fluid connector to filter a fluid stream passing out of the first culture compartment and into the through bore of the fluid connector;

(g) a fluid outlet;

(h) a distal end piece mounted on the distal end of the second culture compartment and connected to the fluid outlet; and

20 (i) an outlet filter supported by the distal end piece.

2. The culture system of claim 1, wherein the connector filter is a molecular weight cut-off membrane that transverses the first culture compartment and is supported on one end by the fluid connector and on a second end by the first end piece.

3. The culture system of claim 1, wherein the outlet filter is a molecular weight cut-off membrane transversing the second culture compartment and supported on one end by the fluid connector and on a second end by the distal end piece.

4. The culture system of claim 2, wherein the outlet filter is a molecular weight cut-off membrane transversing the second culture compartment and supported on one end by the fluid connector and on a second end by the distal end piece.

5. The culture system of claim 1, wherein the outlet filter is a membrane carrier assembly transversing the second culture compartment wherein the membrane carrier assembly has:

a support cylinder having a first end supported by the fluid connector and a second end supported by the distal end piece;

a molecular weight cut-off membrane secured to an exterior surface of the support cylinder, and

a chamber between the exterior surface of the cylinder and an interior surface of the membrane, the chamber in fluid communication with the through bore of the fluid connector and the fluid outlet.

6. The culture system of claim 1, wherein the through bore of the fluid connector is intersected by a through bore of a second fluid inlet.

7. The culture system of claim 1, further comprising at least one penetration port extending through a wall of the first or second culture compartment.

8. The culture system of claim 1, further comprising a gas venting means for allowing gas to escape from the first or second culture compartment as the compartment
5 is filled with fluid.

9. The culture system of claim 1, further comprising a fill means for inserting fluids into or removing fluids out of the first or second culture compartment.

10. The culture system of claim 1, wherein the first end, the distal end and the fluid connector are concurrently rotated by a drive assembly.

10 11. The culture system of claim 1, wherein the second culture compartment has a greater volume than the first culture compartment.

12. The culture system of claim 1, further comprising an identifier.

13. The culture system of claim 12, wherein the identifier is a bar code.

14. A culture system comprising:

15 (a) a fluid inlet;

(b) a first culture compartment having

(i) a tubular sleeve,

(ii) a growth compartment within the sleeve,

(iii) a first end piece attached to the fluid inlet on one side and to a first

20 end of the tubular housing on a second side, and

(iv) a membrane carrier assembly transversing the growth compartment comprising

a support cylinder,

a molecular weight cut-off membrane secured to an exterior
5 surface of the support cylinder, and

a chamber between the exterior surface of the cylinder and an interior surface of the membrane, the chamber in fluid communication with the fluid inlet and the growth compartment;

(c) a second culture compartment coaxial with the first culture compartment,
10 the second culture compartment having a proximal end and a distal end;

(d) a fluid connector having a first side mounted on a second end of the tubular sleeve and a second side mounted on the proximal end of the second culture compartment, the fluid connector having a through bore passing from the first side to the second side of the fluid connector wherein the through bore is in fluid communication
15 with the chamber of the membrane carrier assembly and the interior of the second culture compartment;

(e) a fluid outlet;

(f) a distal end piece mounted on the distal end of the second culture compartment and connected to the fluid outlet; and

20 (g) an outlet filter supported by the distal end piece.

15. The culture system of claim 14, wherein the outlet filter is a molecular weight cut-off membrane transversing the second culture compartment and supported on one end by the fluid connector and on a second end by the distal end piece.

16. The culture system of claim 14, wherein the outlet filter includes:

5 a cylindrical support transversing the second having a first end supported by the fluid connector and a second end supported by the distal end piece;

a molecular weight cut-off membrane secured to an exterior surface of the cylindrical support, and

10 a channel between the exterior surface of the cylindrical support and an interior surface of the membrane, the channel in fluid communication with the through bore of the fluid connector and the fluid outlet.

17. The culture system of claim 16, wherein the molecular weight cut-off membrane transversing the growth chamber has a different molecular weight cut-off than the molecular weight cut-off membrane of the outlet filter.

15 18. The culture system of claim 16, wherein the molecular weight cut-off membrane transversing the growth chamber is identical to the molecular weight cut-off membrane of the outlet filter.

19. A culture system comprising:

(a) a fluid inlet;

20 (b) a first culture compartment having a tubular housing;

(c) a first end piece attached to the fluid inlet on one side and to a first end of the tubular housing on a second side,

(d) a second culture compartment coaxial with the first culture compartment, the second culture compartment having a proximal end and a distal end;

5 (e) a fluid connector having a first side mounted on a second end of the tubular housing and a second side mounted on the proximal end of the second culture compartment, the fluid connector having a through bore passing from the first side to the second side of the fluid connector;

10 (f) a connector filter positioned on the first side of the fluid connector to filter a fluid stream passing out of the first culture compartment and into the through bore of the fluid connector;

(g) a fluid outlet;

(h) a distal end piece mounted on the distal end of the second culture compartment and connected to the fluid outlet; and

15 (i) an outlet filter transversing the second culture compartment including:

a support cylinder having a first end supported by the fluid connector and a second end supported by the distal end piece,

a molecular weight cut-off membrane secured to an exterior surface of the support cylinder, and

20 a chamber between the exterior surface of the cylinder and an interior surface of the membrane, the chamber in fluid communication with the through bore of the fluid connector and the fluid outlet.

20. A culture system comprising:

(a) a fluid inlet;

(b) a first culture compartment having a tubular housing;

5 (c) a first end piece attached to the fluid inlet on one side and to a first end of the tubular housing on a second side,

(d) a fluid connector having a first side mounted on a second end of the tubular housing, the fluid connector having a through bore passing from the first side to a second side of the fluid connector;

10 (e) a connector filter positioned on the first side of the fluid connector to filter a fluid stream passing out of the first culture compartment and into the through bore of the fluid connector;

(f) a culture bag including

15 a flexible external wall having a first end, a second end, an internal side, and an external side, wherein the internal side of the external wall is positioned to face an interior of the culture bag,

a first bag end fused to the first end of the external wall and attached to the second side of the fluid connector,

a second bag end fused to the second end of the external wall, and

an outlet filter supported by the second bag end; and

20 (g) a fluid outlet.

21. The culture system of claim 20, wherein the external wall comprises at least one sheet having a seam formed by fusing overlapped sections of one or more sheets.

22. The culture system of claim 20 having a plurality of culture bags.

5 23. The culture system of claim 20, further comprising at least one perfusion tube having a proximal end attached to the first bag end and a distal end positioned within the interior of the culture bag, wherein a lumen of the perfusion tube is in fluid communication with the through bore of the fluid connector and the interior of the culture bag.

10 24. The culture system of claim 20, further comprising a plurality of internal perfusion tubes extending from the first bag end into the interior of the culture bag, wherein the internal perfusion tubes have different lengths.

25. The culture system of claim 20, further comprising a plurality of internal perfusion tubes extending from the first bag end into the interior of the culture bag, wherein at least one internal perfusion tube has a distal end attached to the external wall.

15 26. The culture system of claim 25, wherein at least one of the internal perfusion tubes is branched.

27. The culture system of claim 23, wherein the perfusion tube has multiple perforations.

20 28. The culture system of claim 20, wherein the fluid outlet includes a fluid-conducting swivel.

29. The culture bag of claim 14, wherein said outlet filter has a predetermined porosity.

30. The culture system of claim 20, wherein the fluid inlet and the fluid outlet are coaxial.

31. The culture system of claim 20, wherein the first end piece and the second bag end are configured to fit within concentric apertures on opposed ends of a rotating
5 bioreactor chamber.

32. The culture system of claim 20, further comprising a gas removal port.

33. The culture system of claim 20, further comprising a fill port.

34. The culture system of claim 20, further comprising an identifier.

35. The culture system of claim 20, wherein the connector filter transverses the
10 interior of the first culture compartment extending from the first end piece to the fluid connector.

36. The culture system of claim 20, wherein the fluid inlet includes a fluid-conducting swivel.

37. The culture system of claim 20, wherein the outlet filter transverses the second
15 culture compartment extending from the second side of the fluid connector to the second bag end.

38. The culture system of claim 37, wherein the outlet filter includes:

a support cylinder having a first end supported by the fluid connector and a second end supported by the second bag end,

20 a molecular weight cut-off membrane secured to an exterior surface of the support cylinder, and

a chamber between the exterior surface of the cylinder and an interior surface of the membrane, the chamber in fluid communication with the through bore of the fluid connector and the fluid outlet.

39. The culture system of claim 38 having a plurality of outlet filters.

5 40. The culture system of claim 35, wherein the connector filter includes:

a support cylinder having a first end supported by the first end piece and a second end supported by the first side of the fluid connector,

a molecular weight cut-off membrane secured to an exterior surface of the support cylinder, and

10 a chamber between the exterior surface of the cylinder and an interior surface of the membrane, the chamber in fluid communication with the through bore of the fluid connector and the fluid outlet.

41. The culture system of claim 20, wherein the fluid bore of the fluid connector is intersected by a through bore of a second fluid inlet.

15 42. A culture system comprising:

(a) a fluid inlet;

(b) a first culture bag having

a flexible external wall having a first end, a second end, an internal side, and an external side, wherein the internal side of the external wall is positioned to face an interior of the first culture bag,

20

a first bag end fused to the first end of the external wall and attached to the fluid inlet,

a second bag end fused to the second end of the external wall, and

a first bag filter positioned on the second bag end to filter a fluid stream passing out of the first culture bag;

(c) a fluid connector having a first side mounted on the second bag end, the fluid connector having a through bore passing from the first side to a second side of the fluid connector;

(d) a second culture bag including

a flexible outer wall having a first end, a second end, an internal side, and an external side, wherein the internal side of the outer wall is positioned to face an interior of the second culture bag,

a proximal bag end fused to the first end of the outer wall and attached to the second side of the fluid connector,

a distal bag end fused to the second end of the outer wall, and

an outlet filter supported by the distal bag end; and

(g) a fluid outlet.

43. The culture system of claim 42, further comprising a housing having concentric apertures for opposed ends.

44. The culture system of claim 42, wherein the first end piece and the distal bag end are configured to fit within concentric apertures on opposed ends of a rotating bioreactor chamber.

5 45. The culture system of claim 42, further comprising a plurality of perfusion tubes positioned within the interior of the first or second culture bag, wherein a lumen of the perfusion tubes is in fluid communication with the through bore of the fluid connector.

46. The culture system of claim 45, wherein the perfusion tubes have different lengths.

10 47. The culture system of claim 45, wherein at least one of the perfusion tubes is branched.

48. The culture system of claim 45, wherein the perfusion tube has multiple perforations.

49. The culture system of claim 42, wherein the fluid inlet and the fluid outlet are coaxial.

15 50. The culture system of claim 42, further comprising an identifier.

51. The culture system of claim 42, wherein the connector filter transverses the interior of the first culture compartment extending from the first end piece to the fluid connector.

20 52. The culture system of claim 42, wherein the outlet filter transverses the second culture compartment extending from the second side of the fluid connector to the distal bag end.

53. The culture system of claim 52, wherein the outlet filter includes:

a support cylinder having a first end supported by the fluid connector and the distal bag end,

a molecular weight cut-off membrane secured to an exterior surface of the support cylinder, and

5 a chamber between the exterior surface of the cylinder and an interior surface of the membrane, the chamber in fluid communication with the through bore of the fluid connector and the fluid outlet.

54. The culture system of claim 51, wherein the connector filter includes:

10 a support cylinder having a first end supported by the first end piece and a second end supported by the first side of the fluid connector,

a molecular weight cut-off membrane secured to an exterior surface of the support cylinder, and

15 a chamber between the exterior surface of the cylinder and an interior surface of the membrane, the chamber in fluid communication with the through bore of the fluid connector and the fluid outlet.

55. The culture system of claim 42, wherein the fluid bore of the fluid connector is intersected by a through bore of a second fluid inlet.